Aquatics (Hydrology, Fisheries, and Riparian)

This section summarizes the condition of aquatic resources on the Bighorn National Forest by first describing the hydrologic environments of watersheds, water bodies, riparian areas, and wetlands. The physical description of the aquatic resource is followed by a description of the fish species that use and are part of the aquatic environment on the forest. Information is drawn from the 9 individual watershed reports completed for the forest plan and other sources as cited. Within the sections there are descriptions of key processes and conditions that act to form and modify the physical and biological characteristics of aquatic ecosystems, such as stream flow, sedimentation, erosion, channel formation, and riparian vegetation. Those processes that can be affected by forest level management decisions are emphasized. A summary of current aquatic conditions across the forest is also included. Much of the background material for this report is summarized from the Upper Columbia River Basin Draft Environmental Impact Statement (USDA 1997).

LEGAL AND ADMINISTRATIVE FRAMEWORK

- The Organic Administration Act (1897) recognizes watersheds as systems that have to be managed with care to sustain their hydrologic function. It states that one purpose for establish nationals forest is to secure favorable conditions for water flow.
- The intent of the Clean Water Act, a series of Acts from 1948 to 1987, is to maintain and restore the chemical, physical, and biological integrity of the nation's waters. It requires compliance with state and federal pollution control measures; allows no degradation of in stream water quality needed to support designated uses; control of nonpoint sources of pollution through conservation or "best management practices"; federal agency leadership in controlling nonpoint pollution from managed lands; and rigorous criteria for controlling pollution discharges into waters of the United States.
- The National Forest Management Act (1976) directs national forest to protect watershed conditions from irreversible damage and to protect streams and wetlands from detrimental impacts. Land productivity must be preserved. Fish habitat must maintain viable populations of existing and desired non-native vertebrate species.
- The Endangered Species Act (1973) requires federal agencies to conserve threatened and endangered species and the ecosystems they depend on, including riparian and aquatic ecosystems.
- The Safe Drinking Water Act (1976) requires federal agencies having jurisdiction over any federally owned or maintained public water system to comply with all authorities respecting the protection of safe drinking water.
- Executive Orders 11988 and 11990 direct federal agencies to avoid to the extent possible the impacts associated with the destruction or modification of floodplains and wetlands. Agencies are directed to avoid construction and

development in floodplains and wetlands whenever there are feasible alternatives.
- The Forest Service Manual (2500) provides additional information on applicable laws and regulations regarding watershed management.
- The Wild and Scenic Rivers Act (1968) provides for preservation, in free-flowing condition, of rivers with outstandingly remarkable values including fisheries.
- Executive Order 12962, Recreational Fisheries, provides direction to federal agencies to provide quality recreational fishing opportunities through habitat restoration, access and education.
- The Forest Service Manual and Forest Service Handbook (2600) provide direction and techniques for managing fishery habitat, cooperating with states and other federal agencies, conducting habitat inventories, restoring degraded habitat and protecting aquatic resources.

HYDROLOGY AND WATERSHED PROCESSES

Summary of Forest-wide Conditions and Trends

Management activities throughout the forest have had varying degrees of impact on the quantity and quality of water, processes of sedimentation and erosion, and the production and distribution of organic material in the watersheds.

The most pronounced changes to watersheds are due to roads (location, crossings, densities, and maintenance), improper livestock grazing, and vegetation alteration (silviculture, fire exclusion, and forage production).

Environmental changes within landscapes commonly culminate to appear as cumulative impacts at the watershed scale.

Discussion of Forest-wide Conditions

Watersheds are natural divisions of the landscape and are the basic functioning unit of hydrologic processes. Watersheds are hierarchical (smaller ones are nested within larger ones). The natural hierarchies of watersheds make them an appropriate context for considering many ecological processes. Physical processes such as rainfall, runoff, erosion, and sedimentation interact within the watershed boundaries to shape the landscape. Biological processes also occur within watershed boundaries. For example, most aquatic species do not cross over watershed divides. Environmental changes commonly culminate and appear at the watershed scale. Changes in soil, vegetation, topography, and chemicals result in changes in the quantity and quality of water, sediment, and organic material that flow through a watershed. Factors that govern how a watershed may respond to environmental change include the size and location of changes, the physical and biological characteristics of the watershed, and the history of natural and human disturbances.

The following table lists the major watersheds, their watershed number, and their sizes that comprise the Bighorn National Forest.

Watershed Name (5th level HUC)	Watershed Number	Watershed Size (Acres within forest boundary)
Upper Little Bighorn River	1008001601	141,815
Upper Tongue River	1009010102	177,068
Upper Goose Creek	1009010101	116,952
Piney Creek	1009020601	69,380
Rock Creek	1009020602	40,875
Upper Clear Creek	1009020603	80,611
Upper Crazy Woman Creek	1009020501	62,797
North Fork Powder River	1009020101	12,527
Tensleep Creek	1008000802	97,123
Brokenback Creek	1008000804	4,007
Paintrock Creek	1008000803	107,943
Shell Creek	1008001001	13,991
Bear Creek	1008001002	10,326
Upper Porcupine Creek	1008001003	5,1091

STREAMS, RIVERS, AND LAKES

Summary of Forestwide Conditions and Trends

Diversions, dams, and impoundments have altered flow regimes in some watersheds. The alteration of basin hydrology occurs only in some watersheds on the Forest. Those watersheds most impacted are: Goose Creek, Clear Creek, Piney Creek and Tensleep Creek. These watersheds contain diversions and dams that provide water for agriculture and domestic use off of the forest.

The banks and beds of some streams, rivers, and lakes have been altered by past tie-hack timber harvest. Where this activity occurred, the streams were cleared of large woody debris to facilitate log drives. The impacts of these activities can still be seen nearly one hundred years after the last log drive. The watershed most affected by channel modification is the South Tongue watershed.

Water quantity (the amount of water produced by a watershed) and flow rates have been locally affected by dams, diversions, and groundwater withdrawal. More subtle changes have resulted from road construction, fire suppression, and changes in vegetation due to silvicultural practices, and improper livestock grazing.

Streams and rivers are highly variable across the forest, reflecting diverse physical settings and disturbance histories. Nevertheless, important aquatic habitat components such as pool frequency, pool depth, and pool-riffle ratio's have decreased throughout much of the forest. Impacts to aquatic habitats are generally highest in areas with higher road and stream crossing densities and in areas with livestock grazing impacts.

Discussion of Forest-wide Conditions

Water quantity and quality are important components of aquatic systems. These elements are also where land management has the biggest influence on the condition of watersheds.

Water Quantity (Amount)

In general, mountains receive more moisture throughout the year than is lost through evaporation and transpiration. This means that mountains are the primary source of water for lowland areas where significantly less precipitation falls. Most surface runoff from the Bighorn Mountains comes during the spring following snowmelt. Summer thunderstorms are common on the west side of the mountains and may generate short-duration high-intensity rainfall. However, these storms generally do not contribute significantly to basin-wide runoff amounts. The amount of surface water draining from a mountainous watershed depends on at least six factors: the water content of the snowpack; the nature of the vegetation; the water-holding capacity of the soil and sapwood of trees; climatic characteristics; the proportion of the water that percolates into the groundwater; the patchiness of the vegetation mosaic, including the potential for snowdrifting (Knight 1994).

The scarcity of water in lowland areas off of the forest has resulted in the development of flow regulation on the forest to provide reliable amounts of water for agriculture in the valley. The storage and irrigation projects, range from small headwater reservoirs (stock tanks) used for livestock grazing up to reservoirs that store large amounts of water. Where present, flow regulation structures have significantly altered the flow regimes of the watershed resulting in changed habitat conditions, especially for those species that have survival strategies adapted to natural flow patterns. Altered flow regimes also affect channel stability by changing the rates and timing of sediment and organic-material transport.

Management on the forest that has altered flow regimes includes: flow impoundment (dams and reservoirs), water withdrawal (diversions and pumping), road construction, and vegetation manipulation. Timber harvest, fire suppression, improper livestock grazing, and associated activities have altered the timing and volume of stream flow by changing on-site hydrologic processes. Changes can be either short-or long-term depending on which hydrologic processes are altered or by the intensity of alteration.

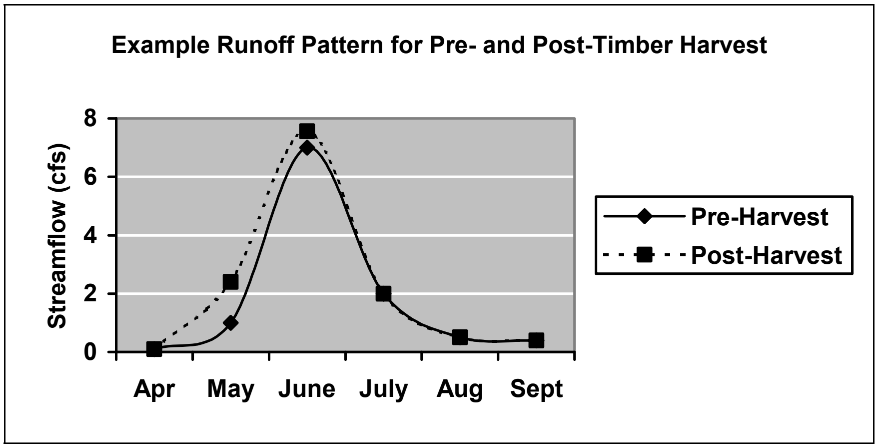


Figure 1. A typical hydrograph for a Rocky Mountain Stream. This shows how timber harvest can generate an earlier runoff with a slightly higher peakflow. Adapted from Knight 1994.

Water Quality

The USFS is working cooperatively with the state to restore impaired waters in a manner that will also allow legitimate and needed land management projects to continue. The USFS will develop a plan, in consultation with the state, to address the pollutants of concern for those portions of a watershed on National Forest System (NFS) lands having impaired waters. The USFS has a process whereby state-listed 303(d) waters on NFS lands are assessed for verification and level of impairment. This process consists of the following: 1) field surveys to verify impairment and identify pollutant sources, and work with the state to refine the list of impaired streams, if necessary; 2) prioritize the pollutant sources, and estimate the percent of pollutant load caused by natural sources and each anthropogenic source, for each listed pollutant on every verified impaired stream; 3) develop a Total Maximum Daily Load (TMDL) plan with the state for each watershed having impaired waters. This plan would include implementing preventative watershed conservation practices and curative restoration programs consisting of management changes and land treatments as needed, disconnecting pollutant sources from waters in priority order, monitoring effectiveness of any changes, treatments, programs, or practices implemented, and reporting the progress to the state in 305(b) reports every two years.

The program that the USFS implements to control nonpoint sources of pollution works on the premise that nonpoint sources can be controlled by relying on state BMP programs, as intended by Congress in CWA Section 319. As applied by the USFS on National Forest System lands, the BMP program consists of: 1) defining practices, based on the best information available, that are expected to protect water quality; 2) monitoring to ensure the practices are applied; 3) monitoring to determine the effectiveness of practices; 3) mitigation to address unforeseen problems; and, 5) adjustment of design specifications of BMPs for future activities, where appropriate. Water quality regulations require that every two years each State review all the available data on water quality to determine which streams are not meeting water quality standards. The following table lists those streams identified on the 2000 State 303(d) report and the source of impairment. The streams listed in the 303(d) report are located below the forest boundary, however activities on the forest can affect downstream water quality.

Basin	HUC	Stream Name	Location	Impaired or Threatened	Impairment /Threat	Priority
Tongue	10090101	Beaver Creek	Impairment from Big Goose Creek to an unknown distance upstream.	Impaired	Fecal	Low
Tongue	10090101	Big Goose Creek	Impairment from Sheridan to above Beckton	Impaired	Fecal	Low
Tongue	10090101	Goose Creek	Unknown distance below Sheridan WWTP	Impaired	Fecal	Low
Tongue	10090101	Jackson Creek	Impairment from Little Goose Creek to an unknown distance upstream	Impaired	Fecal	Low
Tongue	10090101	Kruse Creek	Impairment from Little Goose Creek to an unknown distance upstream	Impaired	Fecal	Low
Tongue	10090101	Little Goose Creek	Impairment from Sheridan to above Big Horn	Impaired	Fecal	Low
Tongue	10090101	Park Creek	Impairment from Big Goose Creek to an unknown distance upstream	Impaired	Fecal	Low
Tongue	10090101	Rapid Creek	Impairment from Big Goose Creek to an unknown distance upstream	Impaired	Fecal	Low
Tongue	10090101	Sacket Creek	Impairment from Little Goose Creek to an unknown distance upstream	Impaired	Fecal	Low
Tongue	10090101	Soldier Creek	Impairment from Goose Creek to an unknown distance upstream	Impaired	Fecal	Low
Powder River	10090205	NF Crazy Woman	Reaches within T49N R82W below forest boundary	Threatened	Fish	Low
Powder River	10090205	Rock Creek	Below forest boundary	Threatened	Fish	Low

Big Goose and Little Goose Creeks (Tongue River basin) were placed on the 1998 303(d) list due to exceedences of the standard for fecal coliform bacteria. Subsequent monitoring in 1998 and 1999 revealed exceedences in several other locations in these watersheds (Kruse Creek, Sacket Creek, and Jackson Creek, Beaver Creek, Park Creek, and Rapid Creek) as well as in Goose Creek and a tributary, Soldier Creek. The Sheridan County Conservation District has started a project to determine the sources of fecal contamination in these watersheds had has begun a locally led effort to mitigate the sources.

In 1998, the Wyoming Department of Environmental Quality (DEQ) determined that a short reach of Hunter Creek, in the Clear Creek watershed, was impacted by excessive sediment. A watershed reconnaissance conducted by the Forest Service and Wyoming Department of Environmental Quality concluded that the sediment was originating from a road that runs directly parallel to the stream. Road modifications and changes to maintenance have been implemented to reduce the pacts. Data indicates that conditions are improving. Hunter Creek will be removed from future 303(d) lists because the TMDL has been approved and implemented.

On the forest, non-point sources of pollution are the primary cause of degraded water quality. A non-point source of pollution is water pollution, whose source(s) cannot be pinpointed, but that can be best controlled by proper soil, water, and land management practices. Examples of non-point sources of pollution include: roads, bank erosion, stream crossings, and cattle trails.

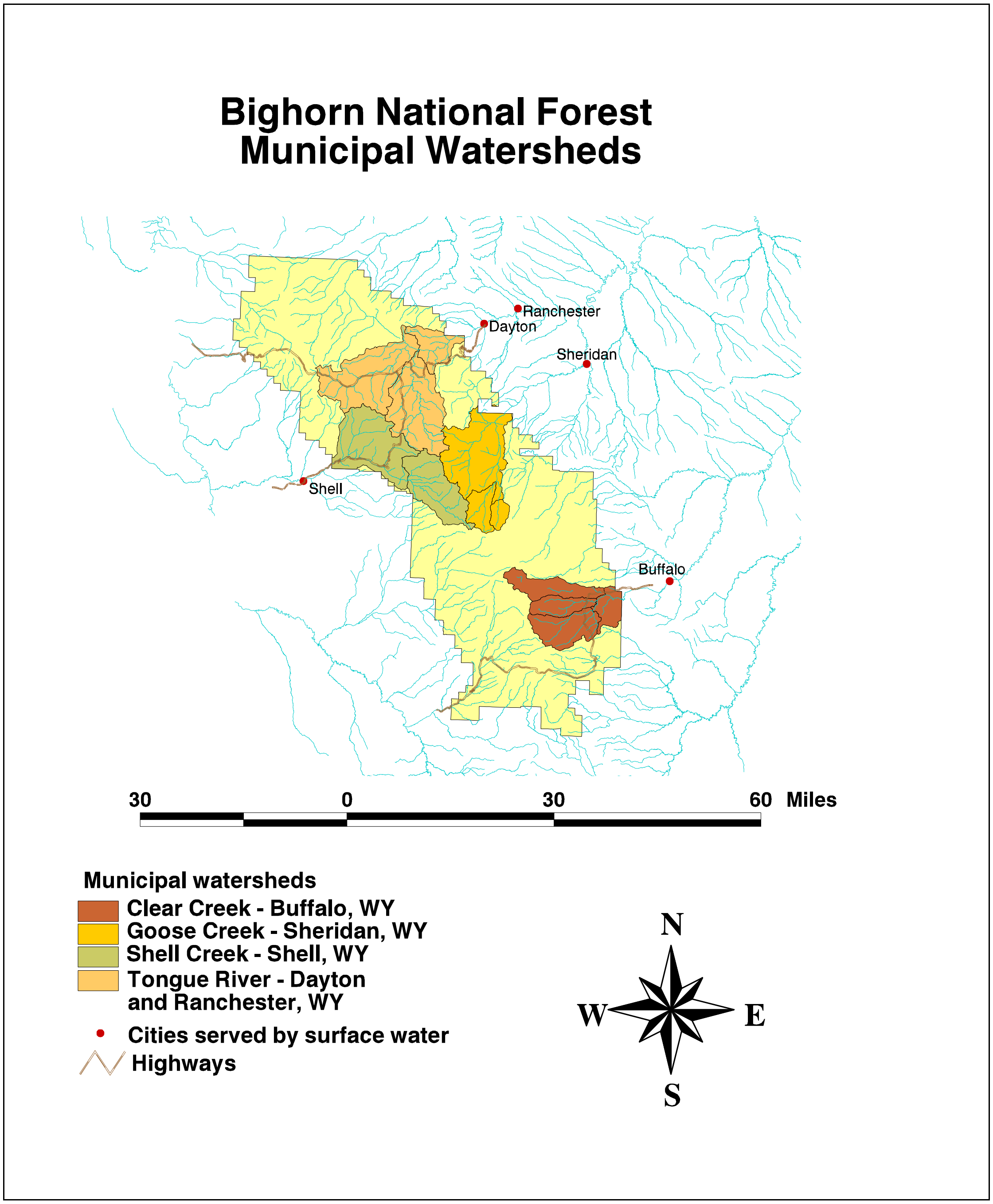
The following table displays the range of road crossing densities within each of the planning watersheds. The higher the road crossing densities, the more likely there will be detectable effects in water quality.

Watershed Name	Number of Stream Crossings	Number of Stream Crossings per Square Mile
Clear/Crazy/Powder	276	1.44
Goose Creek	108	0.86
Tensleep Creek	174	1.51
Devil’s Canyon	86	0.90
Little Bighorn	165	0.74
Paintrock Creek	118	1.11
Piney/Rock Creeks	17	0.14
Tongue River	337	1.22
Shell Creek	173	0.96

Municipal Watersheds

Streams originating on the Bighorn National Forest provide an important source of year-round water for the arid areas lower in the valley. One of the most important off-site uses of water produced on the forest is for domestic use. There are five cities located at the base of the mountains that rely on surface water that originates on National Forest System lands. The State of Wyoming Department of Environmental Quality (DEQ) does not officially designate watersheds that produce water for domestic use. However, the State does designate Class 2AB as waters that have sufficient water quality and quantity to support drinking water supplies and protect those waters for that purpose. The following watersheds have been identified by the State as being suitable for drinking water and have been identified by the Environmental Protection Agency as serving community water systems.

Watershed Name	State of Wyoming Surface Water Classification	Water Systems that Serve the Same People Year-Round
Goose Creek	Class 2AB	City of Sheridan, WY VA Medical Center
Tongue River	Class 1	City of Dayton, WY City of Ranchester, WY
Clear Creek	Class 2A	City of Buffalo, WY
Shell Creek	Class 2AB	City of Shell, WY



Stream Channels

Water, sediment, solute, and organic material derived from hillsides and their vegetative cover flow into and through streams. The shape and character of stream channels constantly and sensitively adjust to the flow of these materials by adopting distinctive patterns such as pools-and-riffles, meanders, and step-pools (Leopold 1964). The vast array of physical channel characteristics combined with energy and material flow, provide diverse habitats for a wide array of aquatic organisms.

The varied topography within the forest, coupled with the irregular occurrences of channel-affecting processes and disturbance events such as fire, debris flows, landslides, drought, and floods, result in a mosaic of river and stream conditions that are dynamic in space and time under natural conditions (Reeves et al 1995). The primary consequence of most disturbances is to directly or indirectly provide large pulses of sediment and wood into stream systems. As a result, most streams and rivers on the forest undergo cycles of channel change on timescales ranging from years to hundreds-of-years in response to episodic inputs of wood and sediment. The types of disturbance, that affect the morphology of a particular channel depends on watershed characteristics, size, and position of the stream within the watershed (Reeves et al. 1995; Grant and Swanson 1995). Many aquatic and riparian plant and animal species have evolved in concert with the dynamic nature of stream channel, developing traits, life-history adaptations, and propagation strategies that allow persistence and success within landscapes that experience harsh disturbance regimes.

Stream classification systems, such as Rosgen (1994), are used to understand and manage streams and rivers according to their geomorphic characteristics. Stream classifications are derived primarily from stream slope, and confinement (the ability of a stream to move and erode its banks and bed). On the forest, stream types range from steep and confined channel that consist of step-pool and cascade morphologies (Rosgen “A” stream type), through moderate gradient and moderately confined rapid-dominated channels (Rosgen “B” stream type), to low gradient, unconfined, riffle-pool dominated channels (Rosgen “C” and “E” stream types). Further discussion on stream types can be found in Rosgen (1994).

In general, steeper channels (slope > 4%) are found in the headwater or mountainous portions of a watershed, and are less sensitive to watershed disturbances because of their high degree of confinement and their position high in the watershed. However, once disturbed, these steep and confined streams may take considerable time to recover to their previous condition. Moderately steep channels (slope 2-4%) generally contain abundant rapids and steep riffles. Lower-gradient streams (slope < 2%) are generally larger, and under natural conditions meander and migrate freely within wider valleys. Low gradient streams and rivers commonly have numerous side channels and high water channels, and generally contain the most biologically proactive aquatic ecosystems. The low-gradient channels are generally sensitive cumulative and local watershed disturbances, but commonly recover quickly when there are natural hydrologic and sediment regimes.

Figure 2. Examples of high and low gradient stream channels on the Bighorn National Forest. Note that the width of the riparian areas differ significantly between the two reaches.

Humans have altered stream channels on the Bighorn to varying degrees since the 1890's. Changes in stream channels have occurred as a result of channelization, wood removal, diversion, dam building, and indirectly by altering the natural incidence, frequency, and magnitude of disturbance events such as wildfire. Initially, heavy livestock grazing impacted riparian areas and stream channels. Historic photographs taken on the forest show riparian areas heavily impacted by large numbers of livestock. After the turn of the 20th century, logging became common in some watersheds on the east side of the mountains. Stream channels were heavily altered to transport logs from the mountain down to the mills in the valley. Splash dams, diversions, and channel modification were common during the tie hack days on some parts of the forest. Other indirect effects of past and present land management activities on streams on the forest have resulted from mining, road building and beaver trapping.

Aspects of channel morphology that have been most affected by land management include the frequency and depth of large pools, the width-depth ratio of stream channels, and the amount of fine sediments stored in the channels. Low gradient stream channels show the most response to land management activities. Lower pool frequencies and higher fine sediment concentrations are most obvious in watersheds with higher road densities and where grazing has been a major management emphasis. These findings are consistent with observations from site-specific analyses that indicate that improper road construction/maintenance, grazing, and timber harvest practices increase delivery of fine sediment to stream channels, filling pools and causing stream aggradations (Furniss et al. 1991; Hicks et al. 1991).

In addition to direct and indirect effects to stream channels, cumulative effects of land management have caused an overall change in the scale and frequency of landscape disturbance, resulting in a distinctly different character of watersheds and their stream systems when viewed from a forest-wide perspective. Instead of individual and isolated watersheds, riparian areas, and stream channels being episodically affected by large disturbances, such as floods, fire, and insect infestations, with other neighboring watersheds remaining largely unaffected, past land management practices of road construction, improper livestock grazing, and timber harvest have led to increased levels of watershed disturbances spread over time and space. Consequently, most watersheds contain stream channels and aquatic habitats that are now subject to continuing cumulative effects of watershed disturbance. This contrasts with the more pulse-like pattern of disturbance under which most streams and associated species evolved. As a result, most stream channels are in a somewhat “unnatural” condition, with habitat conditions that are less than optimal for aquatic and riparian-dependant species, which evolved in environments that probably had many more high-quality habitat areas spread across the landscape.

Lake Environments

Some lakes within the forest have been affected by recreation and livestock uses. Recreation activities such as backpacking, horsepacking, recreational vehicle use, and road and trail development have resulted in damage to lake environments, particularly near-shore areas. Water transfers and diversions for drinking water or irrigation water supplies have affected and continue to affect many lakes throughout the forest, especially where drought and diversion of inflow have resulted in very low lake levels. Dozens of lakes have their shorelines influenced by modification and control of their outlet streams. Regulation of lake levels for water supply purposes has had effects on near-shore aquatic and wetland plant and animal communities, and the spawning success of near-shore spawning fishes.

The following table lists the acres of lakes within each planning unit.

Watershed Name	Surface Acres of Lakes
Devil’s Canyon	4
Shell Creek	365
Paintrock Creek	1,016
Tensleep Creek	862
Clear/Crazy	740
Piney/Rock	1,312
Goose Creek	1,678
Tongue River	149
Little Bighorn River	9

RIPARIAN AREAS AND WETLANDS

Summary of Forestwide Conditions and Trends

The overall extent and continuity of riparian areas and wetlands has decreased, primarily due to channel incision and lowering of local water tables.

Riparian ecosystem function, determined by the amount and type of vegetation cover, has decreased in most planning areas across the forest.
A large percentage of the non-forested riparian areas on the forest are in a degraded condition as a result of historic livestock and wildlife grazing pressure. There is some information to support that fact that riparian area conditions are beginning to improve, however the rate of recovery is very slow.

Within forested riparian areas, the abundance of mid-and late-seral vegetation has increased whereas the abundance of early seral structural stages has decreased. The reason is attributed primarily to fire suppression.

The frequency and extent of seasonal floodplain and wetland inundation have been altered by changes in flow regime due to water diversions and by changes in channel geometry due to sedimentation and erosion, channelization, and installment of transportation improvements such as roads.

There is an overall loss of late-seral willow in non-forested riparian areas.

Discussion of Forest-wide Conditions

Riparian areas and wetlands cover a relatively small portion of the forest, their ecological significance however, far exceeds their limited physical area. Riparian areas and wetlands are an important component of the overall landscape forming some of the most dynamic and ecologically rich areas on the landscape. Riparian areas exist in the rangeland and forestland environments throughout the forest. Riparian and wetland systems are responsive and dynamic, and when modified, can seriously affect adjacent aquatic and terrestrial ecosystems.

Riparian areas are water-dependent systems that consist of lands along, adjacent to, or contiguous with streams, rivers, and wetland systems. Riparian ecosystems are the ecological links between uplands and streams, and between terrestrial and aquatic components of the landscape. Many riparian areas have wetlands associated with them. While riparian areas are defined primarily on the basis of their nearness to streams and rivers, wetlands occur wherever the eater table is usually at or near the ground, or where the land is at least seasonally covered by shallow water. Wetlands across the forest include marshes, shallow swamps, lakeshores, sloughs, bogs, and wet meadows. They are an important part of the overall landscape, providing major contributions to ecosystem productivity, and structural and providing biological diversity, particularly in the arid Bighorn Mountains.

Important physical processes in riparian areas primarily related to the interactions between stream channels, adjacent valley bottoms, and riparian vegetation, which depend on the frequency of floodplain inundations. Water that infiltrates into the floodplain during periods of high flow, returns to the channel during periods of low flow, contributing a cool source of summer base flow for many streams, especially in low-elevation alluvial valleys. Seasonal inundation of the floodplain results in over bank deposition and enrichment of riparian soils. Inundation of floodplain also reduces water velocities during flooding and aids in reducing downstream flood peaks, both factors that reduce the risk of channel erosion. Inland wetlands perform many of the same functions, such as detaining storm runoff, reducing flow peaks and erosion potential, retaining and filtering sediment, and augmenting groundwater recharged by storing water and releasing it more slowly, later in the dry season.

Riparian vegetation also plays a role in many physical processes within riparian areas. Vegetation shades streams and moderates water temperatures by helping deep waters cool in the summer and providing an insulating effect in the winter. Densely vegetated riparian areas buffer the input of sediment from hillslopes and filters fertilizers, pesticides, herbicides, and sediment from runoff generated on adjacent lands. Riparian vegetation also promotes bank stability and contributes organic matter and large woody debris to some stream systems, which is an important component of instream habitat conditions. Complex off-channel habitats, such as backwaters, eddy, and side channels, are often formed by the interaction between streamflow and riparian vegetation such as living vegetation and large woody debris. These areas of slower water provide critical refuge during floods for a variety of aquatic species, and serve as rearing areas for juvenile fish. Additionally, streams and riparian areas are dynamic and change in response to upslope and broader landscape processes and disturbances. These disturbances may influence stream pattern and profile, but typically valley width and gradient do not change. Valley bottoms are generally stable physical settings that contain dynamic components of stream types and riparian vegetation. The shape, size, steepness, of the valley bottom and stream corridor side-slopes have profound effect on the development of in-stream morphology and aquatic habitat.

Riparian and Wetland Vegetation

Most riparian and wetland areas within the project area stand out because of their unique vegetation. In drier parts of the forest, ribbons of dense vegetation flank streams and rivers, in distinct contrast to the surrounding uplands and valley bottoms. The forest has a broad-scale map of the riparian areas on the forest. The following table displays the acres of riparian within each of the planning units.

Watershed Name	Acres of Riparian
Devil's Canyon	5,594
Shell Creek	10,693
Paintrock Creek	10,883
Tensleep Creek	10,119
Clear/Crazy	14,257
Piney/Rock	10,704
Goose Creek	14,004
Tongue River	18,656
Little Bighorn River	9,686

Riparian conditions on the Bighorn National Forest are highly variable. Overall, riparian areas on the forest are functioning at or near their potential and are considered to be improving. However, there are many areas where they are functioning below their potential. The major factors leading to a decrease in riparian area function are: improper livestock grazing, timber harvest, fire management, road development, and water diversions. To a lesser degree, disturbances associated with recreational use have also led to decreasing riparian area function. On grasslands, improper livestock grazing has been the most important factor leading to degraded riparian areas. Improper livestock grazing can lead to bank damage, species conversion, and sedimentation. On forested landscapes, silviculture, road building, and fire suppression have altered riparian conditions by changing flow regimes and altering channel morphology. When disturbances to the riparian area are significant, they may modify the interaction between the floodplain and the channel. Impacts to the riparian area can lead to a decrease in the function and habitats provided by a healthy riparian area.

Watershed Name	Miles of Road within Riparian
Devil's Canyon	6
Shell Creek	13
Paintrock Creek	8
Tensleep Creek	13
Clear/Crazy	32
Piney/Rock	2
Goose Creek	16
Tongue River	56
Little Bighorn River	11

FISHERIES

Summary of Forest-wide Conditions and Trends

The composition, distribution, and status of fishes within the Forest have changed from historic conditions.

Where present, native fish (Yellowstone cutthroat trout) are vulnerable to extinction due to their restricted distribution and small numbers.

Threats to remaining native fishes come from hybridization, habitat degradation, angling, and flow alterations.

Core areas for rebuilding populations of native fish occur across the forest.

Discussion of Forest-wide Conditions

The Yellowstone cutthroat trout (Oncorhynchus clarki bouvieri) is the native trout of the Bighorn Mountains, although it is generally considered unlikely they were native to the Powder River watershed. Individual populations of the Yellowstone subspecies have evolved numerous life-history characteristics in response to the diverse environments in which they have been isolated since the last glacial retreat. Anthropogenic activities have resulted in a substantial reduction in the historical distribution of this subspecies, and many unique local populations have been extirpated. As a result, the Yellowstone cutthroat trout has been designated as a species of special concern – class A by the American Fisheries Society.

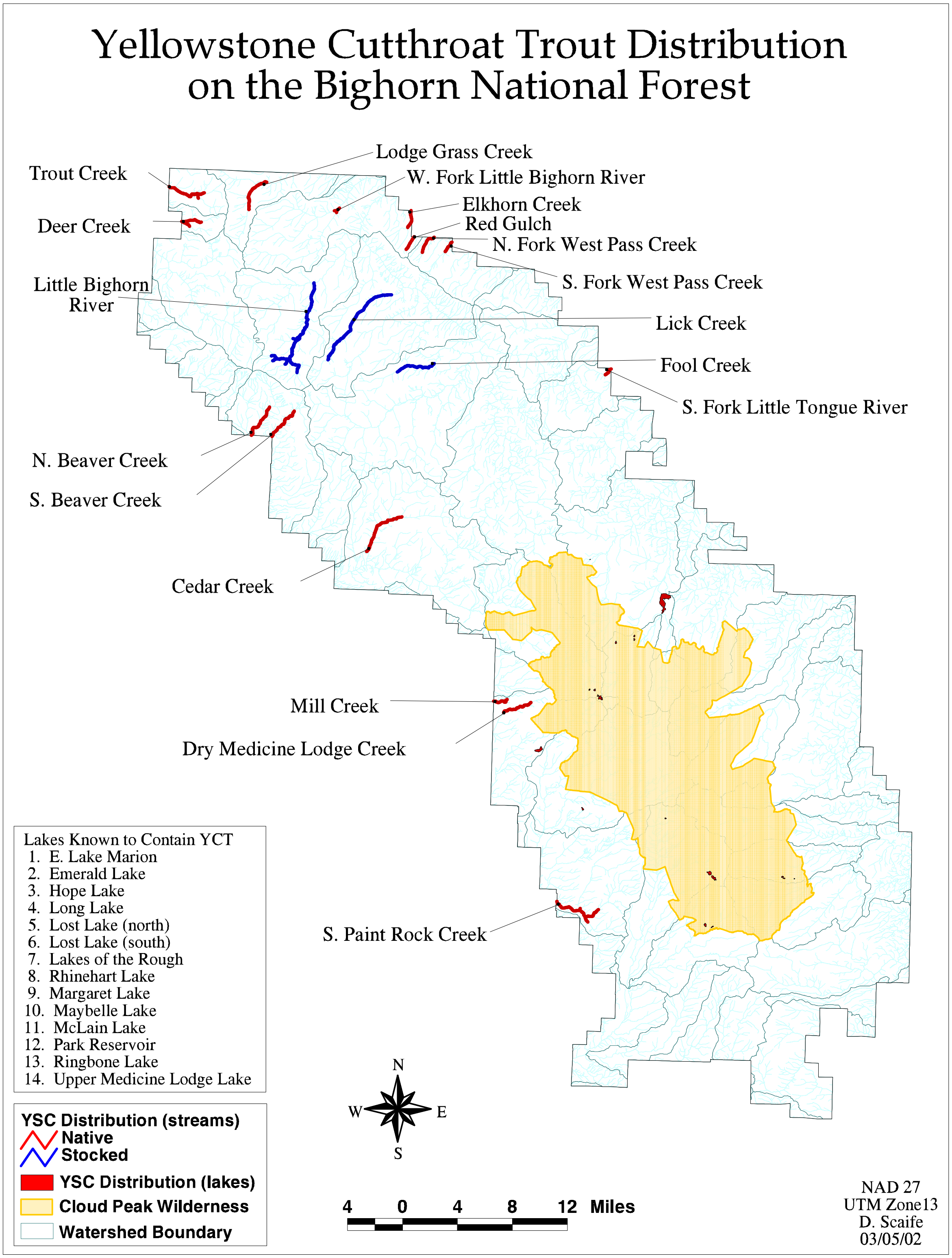
Historical Distribution

The Yellowstone cutthroat trout is more abundant and inhabits a larger geographical range in the western US than any other non-anadromous subspecies of cutthroat trout. Yellowstone cutthroat trout were historically found in the Yellowstone River drainage in Montana and Wyoming and in the Snake River drainage in Wyoming, Idaho, Utah, Nevada, and Washington.

Current Status and Distribution

Beginning in 1998, the Forest has worked with the Wyoming Game and Fish Department to inventory the distribution of Yellowstone cutthroat trout within the historical range in the Bighorn Mountains. The current distribution of Yellowstone cutthroat trout in the Bighorn Mountains can be found in the project file. There are known populations of genetically pure Yellowstone cutthroat trout on both the east and west sides of the Forest. Most populations are small and isolated in short reaches of remote streams. All populations are at risk of introgression from non-native species.

Natural populations of Yellowstone cutthroat trout are found in very small isolated pockets of remote streams on the Forest, none of which are in this analysis area.



Yellowstone Cutthroat Trout Distribution on the Bighorn National Forest
Lodge Grass Creek
Trout Creek
W. Fork Little Bighorn River
Elkhorn Creek
Deer Creek
Red Gulch
N. Fork West Pass Creek
Little Bighorn River
S. Fork West Pass Creek
Lick Creek
Fool Creek
S. Fork Little Tongue River
N. Beaver Creek
S. Beaver Creek
Cedar Creek
Mill Creek
Dry Medicine Lodge Creek
S. Paint Rock Creek
Lakes Known to Contain YCT
1. E. Lake Marion
2. Emerald Lake
3. Hope Lake
4. Long Lake
5. Lost Lake (north)
6. Lost Lake (south)
7. Lakes of the Rough
8. Rhinehart Lake
9. Margaret Lake
10. Maybelle Lake
11. McLain Lake
12. Park Reservoir
13. Ringbone Lake
14. Upper Medicine Lodge Lake
YSC Distribution (streams)
Native
Stocked
YSC Distribution (lakes)
Cloud Peak Wilderness
Watershed Boundary
N
W
E
S
4 0 4 8 12 Miles
NAD 27
UTM Zone13
D. Scaife
03/05/02

Life History Characteristics

Low genetic diversity among populations of Yellowstone cutthroat trout may reflect a substantial compression of the geographic range of the subspecies during the Pleistocene. In contrast, life-history strategies across the range, and even within individual assemblages of Yellowstone cutthroat trout, are highly diversified. The variability in life-history strategies may represent a complex response to environmental variability operating at different temporal and spatial scales.

Habitat Relationships

Yellowstone cutthroat trout occupy diverse habitats. Lacustrine populations inhabit waters ranging in size from small beaver ponds to large lakes. Fluvial populations were historically present in streams ranging in size from large rivers to small first-order tributaries with mean widths of one meter and less.

The subspecies is well adapted to relatively cold, harsh environments. Although Yellowstone cutthroat trout are associated with cold water habitats, researchers report that water temperatures within portions of the historical range exceeded 26 degrees C. Most large river warm water populations have been extirpated; however, several populations have been documented in geothermically heated streams in Yellowstone National Park.

Key Factors Influencing Yellowstone Cutthroat Trout

Introgression with introduced salmonids is clearly a key factor in the decline of Yellowstone cutthroat trout. Hybridization resulting from introductions of rainbow trout and nonnative cutthroat trout is believed to be a primary cause in the decline of this subspecies. Hybrids are developmentally successful, and progeny may appear as morphological and meristic intermediates between parental types or virtually identical to a singe parental type. Consequently, verifying genetic integrity with morphological data alone is virtually impossible.

Habitat degradation is a second factor important in the decline of this trout. Activities such as dam construction, water diversions, grazing, mineral extraction, road construction, and timber harvest have substantially degraded environments throughout the range of Yellowstone cutthroat trout.

Recreational use can also be a significant source of disturbance. Anthropogenic activities such as road construction have resulted in barriers to migration, reduced flows, sediment deposition, groundwater depletion, stream bank instability, erosion, and pollution. Efforts to curtail human activities and restore degraded stream segments are increasing, but habitat degradation continues.

Effects of livestock grazing on riparian habitats are well documented. In the range of the Yellowstone cutthroat trout, researchers have reported that intensive livestock grazing has caused degradation of riparian areas and subsequent stream bank sloughing, channel instability, erosion, and siltation. Alterations are broadly distributed.

Angling is another factor that may play an important role in the status of remaining Yellowstone cutthroat trout. Yellowstone cutthroat trout are extremely vulnerable to angling, and angler harvest has contributed to substantial declines in population abundance throughout the historical range of the subspecies.

Natural and human causes of change affecting aquatic life

Wildfire has been a common agent of change in the assessment area since the Mesozoic. Present aquatic systems have evolved in response to, and in accordance with, fire. The effects of fire on aquatic systems may be direct and immediate (i.e., increased water temperature) or indirect occurring over an extended period. Ultimately fire results in a natural mosaic of habitats and populations. The persistence of species in freshwater aquatic systems is linked to adaptation to periodic perturbations such as those resulting from wildfire. In fact, the metapopulation concept is focused on the periodic loss of habitat patches (local extirpations) and subsequent re-invasion by individuals from neighboring patches (dispersal). In an ecologically functioning stream network that provides sufficient stream connectivity for species refuge, reestablishment of fishes is generally rapid.

The long-term effects of fire usually result from erosion. Erosional processes potentially change channel morphology, sediment composition and concentration, food availability, and recruitment and distribution of large woody debris. The intensity and scale of these effects are related to the size and intensity of the fire, geology, topography, and size of the stream system, and amount, intensity, and timing of subsequent precipitation events. Physical properties of soil that influence water retention are altered by heating, and in some cases, soils become water repellent after severe burns. The amount of vegetation remaining in a watershed after a fire directly influences runoff and erosion by physically mediating the force of precipitation on soil surfaces, altering the evapotranspiration cycle, and providing soil stability through root systems. Runoff rate and pattern and subsequent erosion potential are directly affected by the amount of organic debris left in the watershed. Revegetation of burned areas is influenced by the intensity and duration of a fire, and the amount and type of new vegetation are related to changes in water yield and nutrient retention in the watershed. Erosional effects of fire generally peak within 10 years following the event.

By the late 1860’s, human activities had begun to alter the assessment area landscape, including the hydrologic function of rivers and streams and features that served as important habitat for aquatic life. By 1900, livestock grazing had reduced extensive willow coverage along many streams to scattered patches. Water withdrawals for irrigation were also developed early and rapidly. Constructing drains, ditches and dikes in valley bottoms and lowlands reduced terrestrial-aquatic interaction. Dams also altered the natural basin hydrology and sediment transport capacity.

In short, the ecological integrity of streams, lakes, and wetlands was significantly compromised by the mid 1900's. Increasing human populations, downstream water demands, and agriculture accelerated greatly following WWII. Individually, and in combination, these activities continue to fragment and compromise the remaining hydrologically connected and vegetated reaches of streams.

Influence Of Non-Native Fish Species Introductions

The introduction of non-native fishes and aquatic invertebrates has had an important influence on species assemblages and aquatic communities throughout the geographic area. Longnose dace (Rhinichthys cataractae) and mountain sucker (Catostomus platyrhynchus) are the species considered to be native to the Powder River watershed, although there is a possibility that Yellowstone cutthroat are also native. Currently at least seven species, subspecies, or stocks of fish have been introduced or have moved into habitats where they did not occur naturally. Most introductions have been made with the intent of creating or expanding fishing opportunities and were initiated in earnest as early as the late 1800's.

Stocking of mountain lakes with cultured stocks of cutthroat, brook, and rainbow trout has been extensive. Many lakes that were historically barren of fish were capable of sustaining them, but lack of spawning habitat or isolation from colonizing populations prevented natural invasion. A variety of species such as lake trout, rainbow trout, golden trout, brown trout, and splake were introduced to diversify angling opportunities, create trophy fisheries, and to provide forage for potential trophy species. Cultured strains of rainbow trout have been widely used to sustain put-and-take fisheries in lakes and rivers where angler harvest or habitat degradation is too excessive to rely on natural reproduction.

Such introductions have led to the elimination of some native populations, while further fragmentation and isolation of other populations have left them more vulnerable to future extirpation. Although introductions have provided increased fishing opportunities and socioeconomic benefits, they have also led to catastrophic failures in some fisheries and expanded costs to management of declining native stocks.

Consequences of introducing non-native species are not limited to a few interacting species. Effects frequently cascade through entire ecosystems and compromise structure and ecological function in ways that rarely can be anticipated. There is a growing recognition that biological integrity and not just species diversity is an important characteristic of aquatic ecosystem health. The loss or restriction of native species and the dramatic expansion of non-native species leave few systems uncompromised.

Influence of Aquatic Habitat Fragmentation and Simplification

The physical environment and the natural and human-caused disturbances to that environment profoundly influence the structure, composition, and processes defining aquatic ecosystems. Aquatic habitat fragmentation (impassable obstructions, temperature increases, and water diversion) and simplification (channelization, removal of woody debris, channel bed sedimentation, removal of riparian vegetation, and water flow regulation) have resulted in a loss of diversity within and among native fish populations. The fragmentation of aquatic systems occurs though natural, dynamic processes as well. Over geologic time river basins become connected or isolated. Within the assessment area, river basins have been isolated by geologic processes that influence the distribution of species and subspecies. Natural populations of Yellowstone cutthroat trout, for example, are found in very small isolated pockets of remote streams on the Forest, none of which are in this analysis area.